

What is claimed is:

1. A communication system comprising:

a satellite communication network;

a terrestrial communication network; and

5 a gateway connecting said satellite communication network and said terrestrial communication network, said gateway comprising

an asynchronous transfer mode (ATM) switching unit for providing an interface with the terrestrial communication network;

10 a satellite modem for communicating with the satellite network; and

an interworking unit interposed between said switching unit and said satellite modem for providing seamless integration between the terrestrial communication network and the satellite communication network by providing traffic and resource management functions, signaling interworking functions, and satellite domain-specific functions.

2. The communication system according to claim 1, wherein said interworking unit comprises a congestion control unit for performing congestion control in the satellite network and back-pressuring terrestrial data traffic based on a current data traffic load in the satellite network.

3. The communication system according to claim 1, wherein said interworking unit comprises a demand-assigned multiple access (DAMA) control unit for allocating satellite bandwidth on demand to the gateway based on a current data traffic carried by the gateway.

5. The communication system according to claim 1, wherein said interworking unit comprises a cell delay variation removal unit for reducing cell delay variation on incoming data from the satellite network.

6. The communication system according to claim 1, wherein said interworking unit comprises a data encryption and decryption unit for performing encryption of data received from the terrestrial network, and decryption of received data from the satellite network.

7. The communication system according to claim 1, wherein said interworking unit comprises a signaling interworking unit for providing signaling interworking between a signaling protocol of the terrestrial network and a signaling protocol of the satellite network.

8. An apparatus for performing interworking between an ATM switch and a satellite modem of a

gateway interconnecting a terrestrial ATM network and a
satellite ATM network, said ATM switch being
communicably linked to said terrestrial ATM network and
said satellite modem being communicably linked to said
5 satellite ATM network, the apparatus comprising:

a. a congestion control unit for performing
congestion control in the satellite network and back-
pressuring terrestrial data traffic based on a current
data traffic load in the satellite network;.

10 b. a demand-assigned multiple access (DAMA)
control unit for allocating satellite bandwidth on
demand to the gateway based on a current data traffic
carried by the gateway;

c. a cell delay variation removal unit for
15 reducing cell delay variation on incoming data from the
satellite network;

d. a data encryption and decryption unit for
performing encryption of data received from the
terrestrial network, and decryption of received data
20 from the satellite network; and

e. a signal interworking unit for providing
signaling interworking between a signaling protocol of
the terrestrial network and a signaling protocol of the
satellite network.

9. The apparatus defined in claim 8, wherein the congestion control unit receives congestion messages from the satellite network via the satellite modem and regulates a rate of transmission of data to each satellite downlink beam from the satellite network.

10. The apparatus defined in claim 8, further comprising

a plurality of queues for each downlink satellite beam for each ATM class of service or each ATM virtual connection, wherein said congestion control unit regulates the rate of transmission of data to each satellite downlink beam by queuing data traffic received from the ATM switch in a corresponding one of said queues or by queuing traffic for each ATM virtual connection in a corresponding one of said queues; and

a traffic scheduler for monitoring queued traffic, a negotiated traffic guarantee for each ATM virtual connection, current congestion in each satellite downlink beam, and the total bandwidth available for transmission of traffic to the satellite, determining the rate of transmission of data traffic to each satellite downlink beam, guaranteeing a minimum rate based on the ATM traffic contract, regulating the rate of flow of excess traffic, using a separate one of said queues for multicast traffic, and controlling the rate

of transmission of multicast traffic based on overall
satellite system load.

11. The apparatus defined in claim 8, wherein
5 said congestion control unit regulates the flow of data
traffic from the terrestrial network on a per-ATM
virtual connection basis by using an Available Bit Rate
(ABR) flow control mechanism.

10 12. The apparatus defined in claim 8, wherein
said congestion control unit regulates the flow of data
traffic from the terrestrial network by setting an
Explicit Congestion Notification (ECN) bit in Internet
Protocol (IP) data packets transported in ATM virtual
15 connections destined to congested satellite downlink
beams.

13. The apparatus defined in claim 8, wherein
said congestion control unit regulates the flow of
20 traffic by controlling an advertised receive window of
TCP connections carried in ATM virtual connections
destined to congested downlink beams.

14. The apparatus defined in claim 8, wherein
25 said congestion control unit regulates the flow of
traffic by a implementing packet discard scheme

15. The apparatus defined in claim 14, wherein
said packet discard scheme includes Early Packet
Discard (EPD), Partial Packet Discard (PPD) or Random
Early Discard (RED).

16. The apparatus defined in claim 8, wherein
said DAMA unit requests bandwidth from a Network
Control Center which manages network resources based on
the current data traffic load at the gateway, receives
bandwidth allocations from the Network Control Center,
and provides the bandwidth allocations to said traffic
scheduler.

17. The apparatus defined in claim 16, wherein
said DAMA unit informs the ATM switch of said gateway
of bandwidth changes received from the Network Control
Center so that the ATM switch limits the flow of data
traffic to the satellite network, and informs the
satellite modem of the allocated bandwidth so that the
satellite modem transmits on correct radio frequencies
at an appropriate time.

18. The apparatus defined in claim 8, wherein
said cell delay variation removal unit reduces cell

delay variation by shaping data traffic received from
the satellite network.

19. The apparatus defined in claim 18, wherein
said cell delay variation removal unit shapes data
traffic based on parameters for each ATM virtual
connection which are obtained by intercepting a virtual
connection traffic descriptor which is exchanged
between the ATM switch of the gateway and a Network
Control Center during call setup.

20. The apparatus defined in claim 8, wherein
said cell delay variation removal unit reduces cell
delay variation by introducing special Operations,
Administration, and Maintenance (OAM) cells containing
time stamps and using the time stamps to determine a
time of arrival of ATM cells at the gateway.

21. The apparatus defined in claim 8, wherein
said a data encryption and decryption unit performs
data encryption of data to be transmitted to the
satellite system and decryption of data received from
the satellite system, using a satellite-network-
specific encryption scheme transparent to the ATM
switch of the gateway.

22. The apparatus defined in claim 21, wherein
said a data encryption and decryption unit obtains key
information for data security by intercepting call
signaling information exchanged during call setup
5 between the ATM switch of the gateway and a Network
Control Center.

23. The apparatus defined in claim 8, wherein
said signal interworking unit provides interworking
10 between terrestrial network signaling protocols and
satellite network signaling protocols.

24. The apparatus defined in claim 8, wherein
signal interworking unit performs ciphering of
15 signaling data within the satellite network.

25. The apparatus defined in claim 8, wherein
signal interworking unit provides authentication of the
gateway within the satellite network.

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